

**ONTARIO SOIL, WATER AND AIR
RESEARCH AND SERVICES COMMITTEE**

2003 ANNUAL REPORT

TO

**ONTARIO AGRICULTURAL SERVICES
COORDINATING COMMITTEE
(OASCC)**

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**ONTARIO SOIL, WATER AND AIR
RESEARCH AND SERVICES COMMITTEE**

2003 ANNUAL REPORT

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EXECUTIVE SUMMARY

The 2003 Ontario Soil, Water and Air research and Services Committee (OSWARSC) Report represents the second year in the four-year reporting cycle to OASCC. The 2002 report outlined the strategic research directions and recommendations for the current four-year period. For sake of brevity, only those priorities identified as being high priority are presented in this document. The reader is referred to the 2003 report for a complete listing of all research priorities. Also identified in this report are emerging issues and concerns regarding both research and service recommendations.

Priority issues identified in previous reports still reflect the pertinent areas of research needs, as well as the concerns of the public and agricultural sectors with respect to the production of safe food in an environmentally sound and sustainable manner. The Research Recommendations have been grouped according to the following Priority Issues:

1. Manure Management
2. Nutrient Use Efficiency
3. Water Management
4. Soil and Crop Management
5. Identification / Validation of Best Management Practices
6. Biosolid / Waste Application and Treatment
7. Rural Air Quality
8. Greenhouse Gas Emissions

"Healthy Soils, Clean Air and Safe Water"

Recent events have focused the public awareness of agriculture on issues surrounding manure and nutrient management, and how agricultural practices affect the quality of our drinking water. Following the passing of the Nutrient Management Act on June 27, 2002 by the provincial government, considerable effort has been placed on the development of the accompanying regulations and protocols. The Nutrient Management Act regulations came into effect on September 30, 2003 for new livestock operations, as well as for existing operations expanding to greater than 300 nutrient units, with other operations to be phased in over the next several years. The expertise of many of the members of the OSWARSC and its subcommittees has been sought in the development of the guidelines, specific regulations and protocols associated with this Act. Progress continues to be made on identifying Ontario agriculture's role in helping Canada meeting its greenhouse gas objectives as outlined in the Kyoto Protocol. Last year, the OSWARSC reaffirmed its commitment to identify required research that meets the present and future needs of the agricultural industry in Ontario and to demonstrate to the public that through the development and implementation of best management practices we can have an agricultural system that provides healthy soils, clean air and safe water.

INTRODUCTION

The Ontario Soil, Water and Air research and Services Committee (OSWARSC) currently consists of three major subcommittees (Ontario Agrometeorology Research and Services Committee (OARSC), Ontario Soil Management Research and Services Committee (OSMRSC) and the Ontario Water Management Research and Services Committee (OWMRSC)). OSMRSC is comprised of six sub-committees pertaining to soil management issues as related to field crops, horticultural crops, soil and water quality, soil test laboratories, tobacco and waste utilization. Memberships and mandates for all of the sub-committee and main committees continue to be reviewed, especially in light of recent changes in how agriculture is practiced and regulated in Ontario.

OSWARSC serves Ontario agriculture by prioritizing research and service needs in the broad areas of:

- ☐ The agricultural and rural community
- ☐ Soil and water management recommendations for agricultural producers
- ☐ Recommendations for agricultural producers that deal with weather and atmospheric conditions

OSWARC continues to organize research recommendations around eight Priority Issues, many of which were identified several years ago. The appropriateness and timeliness of these identified Priority Issues is quickly realized when one considers the recent events such as the Walkerton tragedy and subsequent Inquiry, the passing of the Nutrient Management Act, and ratification of the Kyoto Agreement. In addition, issues concerning water supply and water taking rights (agricultural and non-agricultural) are becoming increasingly important in light of consecutive growing seasons of hot, dry weather across large areas of the province.

Many of the specific strategic research recommendations cut across several of the Priority Issues. This re-enforces the need and importance of developing multi-disciplinary projects rather than smaller individual projects to address the larger issues and the need for increased support of longer-term research projects that can properly address these issues.

OSWARSC TERMS OF REFERENCE

The Ontario Soil, Water and Air Research and Services Committee (OSWARSC) was formed in 1971 and consists of three subcommittees, namely the Ontario Agrometeorology Research and Services Committee, the Ontario Soil Management Research and Services Committee and the Ontario Water Management Research and Services Committee.

Duties and Terms of Reference

1. To identify soil, water and air research required in relation to present and future needs and opportunities for development of the agricultural industry in Ontario.
2. To assess and make recommendations on the priorities to be applied to these matters.
3. To facilitate means of meeting such needs efficiently with the resource available from time to time by:
 - a. Considering and approving chairmen and membership of subcommittees;
 - b. Evaluating cost-benefits of research;
 - c. Examining the suitability of institutions or persons to assume responsibility for various research programs;
 - d. Projecting resources needed for research;
 - e. Describing how resources may be obtained or freed for new program requirements;
 - f. Reviewing operations of subcommittees through reports submitted;
 - g. Reporting to OASCC on such matters as required; and
 - h. Promoting greater interaction between scientists in soil management, water management, agrometeorology, and soil survey and land use, and between scientists and extension personnel.

OSWARSC INDUSTRY/SECTOR SCAN

1. Major accomplishments in the past year

The passing of the Nutrient Management Act, Bill 81, and the subsequent development of regulations have relied heavily on Ontario based research related to the priority areas identified by OSWARSC. September 30, 2003 was the date that the regulations came into effect for new livestock operations and expanding operations (> 300 nutrient units). Research is ongoing and still needed under many of these priority areas to ensure that nutrient management plans achieve the level of acceptable environmental risk without becoming unreasonably prohibitive from the viewpoint of agricultural production. Numerous workshops and information sessions have been held regarding the Act and its implications for agricultural operations.

Since the signing of the Kyoto accord by the federal government, several new research initiatives have been developed in Ontario. The Ontario Soil and Crop Improvement Association in cooperation with the Innovative Farmers' Association of Ontario are administering Ontario's allotment of funds made available to the Soil Conservation Council of Canada by Agriculture and Agri-Food Canada. These funds are being used to develop and verify best management practices for greenhouse gas mitigation through enhancement of on-going research and establishment of demonstration projects. These projects deal not only with methods of carbon sequestration, but more importantly from the perspective of Ontario agriculture, methods of nitrogen management that will reduce nitrous oxide emissions.

To address many of the issues facing efficient nitrogen utilization in Ontario agriculture, from both a nutrient management and greenhouse gas production, an Ontario Nitrogen Forum, organized by the Ontario Ministry of Agriculture and Food is scheduled to take place on March 3 and 4 in Niagara Falls. Members of the research, industry and extension communities are expected to attend to discuss the current state of knowledge on nitrogen management and options for building future nitrogen recommendations.

2. State of the Industry

We continue to see the impact of Commissioner Dennis O'Connor's report of the Walkerton Inquiry on January 18, 2002 as keeping water quality as a fairly high profile issue in the public eye. Subsequent passing of the Nutrient Management Act by the provincial government re-enforced the governments pledge to ensure clean safe water in the province. September 30, 2003 marked the date on which regulations under the Nutrient Management Act came into effect for new livestock and expanding (>300 nutrient units) operations, while other operations are being phased in over the next several years. As stated last year, many in the agricultural community applaud the concept of Nutrient Management Planning, however there still remains a reasonable

amount of anxiety regarding the specific details in the regulations and the potential impact on farm operations and profitability. Coupled with the uncertainty of what the on-farm implications of the Kyoto accord and the status of programs such as the Environmental Farm Plan, has made it difficult if not impossible for some producers to make truly informed business decisions.

Although one can only speculate at the moment, implementation of Nutrient Management Plans will likely have a negative impact on the quantity of fertilizer used and sold in the province, especially as more operations come under the regulations. Requirements of soil test information for the development and monitoring of a Nutrient Management Plan is expected to increase the number of soil samples sent to soil testing laboratories for nutrient analyses.

The 2003 growing season was considerably better from some areas of the province than the previous three growing seasons, although spring rains made timely planting in some regions quite difficult. Some areas experienced a third straight year of unusually dry conditions through July and August. As seen in previous years, situations that bring about reduced stream flow are of particular concern to many growers who rely upon local waterways as a source of irrigation water for crops. Issues surrounding water taking for agricultural and non-agricultural usage continue to be important.

3. Emerging Issues

As indicated in last years report, many producers continue to express concerns regarding the future of the current agricultural industry in Ontario as they deal with the dilemma of decreasing profit margins and increased public scrutiny regarding the impact of farming practices on the environment. The extent to which the implementation of Nutrient Management Plans addresses the public's concern regarding agriculture and the environment remains to be seen. It is still quite clear that media coverage of events surrounding water and air quality problems linked to agriculture sends a powerful message to the public that there can be environmental problems with agriculture. The task at hand is to clearly demonstrate to the public that with the implementation of Best Management Practices, farmers can be both profitable and good environmental stewards. Development of said practices requires an understanding the effects of management on transport pathways of pesticides, nutrients and pathogens, as well as its impact on nutrient cycling. These are critical processes that must be understood in order to assess agriculture's impact on water quality and the appropriate actions to take to ensure the safety of our water. Production systems that promote and maintain soil health benefit agricultural production as well as society as a whole through improvements in both water and air quality. Research that aims at developing sound, economically profitable, and socially acceptable farming systems and technologies must be initiated and supported.

One major limitation identified by in the development of nutrient management plan regulations was the lack of Ontario based data pertaining to nutrient requirements and nutrient removal for many of the horticultural crops grown in Ontario. This had been recognized as a research need for several years, but limited funding made it difficult to get a significant research thrust initiated in this area. We are pleased to report that research activity in this area increased in 2003 and indications are that 2004 will also see greater activity in this area. Similarly, there has been an increase in the amount of research effort pertaining to manure management that address specific agronomic and environmental concerns. Such research activities are extremely important and the efforts made in these areas need to be continued.

Research has demonstrated that with rising temperatures, crop yields tend to decline and display greater variability. While the current trend of global warming is not conclusive proof of greenhouse warming vs. natural variation, it does suggest that if this trend continues we can expect lower more variable yields that will in turn impact on supply, quality and pricing. Management systems, cultivars etc., must be developed and selected not only to tolerate seasonal variability in weather (i.e. higher temperatures and greater risk of drought), but also to produce adequate yield and quality (visual and nutritional). The risk of high temperatures will also place more demand for irrigation water and improved methods of irrigation scheduling.

4. Summary of Soil, Water and Air Issues

This section attempts to provide an overview of the major issues identified by the three subcommittees. These are divided out into issues and research priorities later in the report, but a more comprehensive view may help to place these issues and priorities into context.

Soil: The Ontario Soil Management Research and Services Committee is concerned with the impacts of soil management on both crop production and environmental quality. As such, it is concerned with the chemical, physical, biological, and to some extent, economic aspects of soil management.

Manure management continues to be a dominant issue in soil management, especially in view of the Nutrient Management Act. Development of the regulations from an environmental standpoint clearly shows that while beneficial agronomic practices have been identified in past research, question remain as to the impacts on the environment. The concentration of the livestock industry, and increased public awareness of off site impacts, have highlighted the need for understanding how to manage manure, and other organic materials, to maximize beneficial effects while minimizing adverse environmental impact, for a wide range of materials and cropping systems.

Also very important is the understanding of the inter-relationship between crop production systems and soil properties and sustainability. This includes crop rotations,

tillage systems and nutrient applications. The development of regulations surrounding the Nutrient Management Act has re-enforced the need to increase the work in this area, particularly as it applies to horticultural crops. These crops have been largely ignored in the past because of the small acreage and wide diversity of crops, but they have the potential for significant environmental impact because of the intensity of the production systems.

Other key areas include identification of sources and pathways of environmental contaminants, and optimization of water management. These issues cross over between soil management, and both water and air management.

Water: The Ontario Water Management Research and Services Committee is concerned with both the quantity and quality of water in Ontario, as it relates to agriculture and rural activities in Ontario. The issues and priorities surrounding this can be summarized in three points:

1. Identify the impacts of changing management practices on the leaching losses of pathogens, nutrients, feed additives (both quantities and timing during the year). To accomplish this, the pathways of contaminant movement need to be quantified, best management practices need to be tested and impacts quantified, and benchmark standards need to be developed for concentrations of contaminants in leaching waters and tile drains.
2. Fair and sustainable water sharing policies need to be developed, to ensure the continued availability of clean water for both agricultural and non-agricultural uses. This may include protection strategies for wellheads and groundwater recharge zones, and innovative irrigation strategies for water conservation and to minimize leaching losses.
3. Both new and old designs for surface and groundwater protection (filter strips, wetlands, tile drain treatment systems, etc.) need to be tested for effectiveness as well as the relative cost and benefit of each system.

Air: The Ontario Agrometeorology Research and Services Committee has focused most of its attention to the effect of weather on crop conditions, particularly with respect to weather based predictive models for irrigation scheduling and pest or disease management. Other identified areas of investigation include: the monitoring and characterization of gas fluxes (especially greenhouse gases) from agricultural lands and potential impact of management practices on these fluxes; assessment of risk of extreme events as related to irrigation requirements and manure management (storage); odours from farms including the methods to identify minimum separation distances and manure treatments to reduce odours; and finally other issues surrounding rural air quality as related to the impact of air pollution on crop production.

Increasing in importance is the issue of climate change that involves two components: measuring and adapting to climate change, and quantifying the net release of greenhouse gases from agricultural activities. Although there is evidence of a trend for global warming, the consequence of this phenomenon on climate change within a given area is still very speculative. However, weather records would suggest that the variability in climate currently being experienced is possibly more the norm, than the relatively stable climatic conditions experienced through the period of time from 1950-1980. Increasing within season and between season variability in weather and climatic conditions will undoubtedly result in greater yield variability, and may adversely affect the quality of certain crops. Management systems and cultivars need to be developed to cope with the potential changes in climatic conditions. Ratification of the Kyoto Agreement will also increase the importance of understanding the role of Ontario agriculture in identifying potential sources and sinks of greenhouse gases.

BACKGROUND INFORMATION FOR THE 2003-2005 PRIORITY ISSUES

As mentioned previously, the research recommendations have been organized around eight Priority Research Issues identified by OSWARSC as areas confronting Ontario Agriculture. The eight Priority Issues are listed below with a brief outline of the background material associated with each issue. Although not specifically list in order of priority, the Committee felt that the first three Priority Issues were of approximately equal importance, and somewhat of a higher priority than the later ones.

1. Manure Management

Research investigating manure management methods for reducing nutrient and contaminant transport off-site, while improving nutrient use efficiency and crop production.

Much of the earlier research conducted on manure management was primarily focused on the agronomic benefits of utilizing this on-farm resource from both a crop and soil perspective. Today, controversy surrounds the management of livestock manure on many Ontario farms. Increasing public concerns regarding environmental protection are requiring farmers to be increasingly careful of how manures are handled in order to eliminate, or at least minimize, leakages of plant nutrients and pathogenic microorganisms from the farming system. Implementation of best management practices for improving manure nutrient utilization on the farm will require an understanding of the intricate relationships between crop management factors, soil and weather conditions, and manure characteristics.

The method of manure storage, various manure treatment options and application techniques can significantly alter the availability and concentration of nutrient within the manure, as well as the survivability of pathogens. Research is required to identify those storage/treatment /application systems that offer significant improvements in reducing the risk of contamination of air and water resources by manures, while still being a practical farming operation. Manure storage, treatment and application as it impacts greenhouse gas production are other areas of potential importance in the near future (see Priority Issue 8).

Water quality concerns of pathogen contamination required not only a knowledge of how management influences transport, but also factors that influence survivability of the pathogen, whether during storage or after application to the soil. Research must not only identify how management (storage, treatment and application) affects the pathways of potential movement of contaminants, but also assess the timeframe in which this may occur. Managed properly, livestock manures can supply an important part of the farmer's crop nutrient needs without damaging the environment. Farm decision-makers

must therefore balance the technical aspect of using these materials as a source of plant nutrients with the environmental aspect of avoiding damage. Moreover, manure management must be thought of as only one aspect of overall farm management. Handling operations must be combined with livestock and crop production and marketing plans, rather than being treated as separate entities.

2. Nutrient Use Efficiency

Research assessing the effects of management practices on nutrient-use efficiency.

Concern over the impact of agricultural activity on the environment has increased in recent years. In the past decade, it has been repeatedly demonstrated that agriculture is a significant source of ground and surface water pollution. The problems associated with environmental contamination have led to policy and legislation that aims at effectively managing the land application of nutrients in an environmentally responsible manner. In general, the overall aim of a fertility program for crop production is to synchronize the availability of nutrients to uptake requirements of growing crops to reduce the risk of environmental contamination. However, a number of gaps in the existing knowledge are present. Nutrient requirements and application recommendations have been based on yield response with little emphasis paid to the environmental consequences or crop quality. In some cases, particularly in the horticultural industry, a database for calibration of fertilizer requirements to soil test values for both yield and quality is lacking. Field variability, cropping practices and differences in nutrient requirements of various crops, placement and time of requirement impact the overall nutrient management scheme. As a result of this concern, there is an urgent need to establish best management practices that involve establishing accurate nutrient requirements, proper application rates, timing, and methods of nutrient application that maintain the viability of the agricultural sector while minimizing the environmental impact.

3. Water Management

Research directed towards the source protection of water quality and quantity.

Issues surrounding water management can be categorized into two broad areas of water quality and quantity. Quality issues relate primarily to the potential contamination of surface and ground water sources through the off-farm losses of agricultural inputs (fertilizers, manures, biosolids, pathogens, pesticides etc.). Most of these issues are addressed at the process or field level in the other Priority Issues. Effective management of water quality will also require the assessment of this resource at a larger scale such as the watershed or aquifer level. Identification of problems and sensitive areas to contamination will rely on the development of methods that assess all sources (agricultural and non-agricultural) and relative sizes of contamination, the

pathways of contamination, potential risks of further contamination, and the capacity of the watershed/aquifer to effectively cope with the contamination.

The importance of the protection of water quantity is most relevant given the recent dry weather and increased use of supplemental water to produce crops. Due to water shortages, provincial ministries are enforcing water use permits and growers are under the watchful eye of the public as they irrigate their crops. In view of predictions based on global warming trends, adapting to a drier climate (or at least a climate with greater risks of droughty conditions) will likely become a necessity. Irrigation of crops is likely to increase under this scenario and as such, sustainable water extraction policy and monitoring systems are required to ensure future supplies. On the farm, research is needed to quantify on-farm water cycles. The development of a research program to investigate the potential of alternative irrigation methods, such as surface drip irrigation and subsurface drip irrigation and controlled drainage, is necessary to better utilize water and nutrients in the production of crops. Crop production systems that incorporate micro-irrigation techniques may increase water-use efficiency through reduced evaporation losses, and improved scheduling which would result in a greater capacity for control of internal drainage and lower the incidence of disease compared with conventional irrigation. Furthermore, drip irrigation with fertigation may provide opportunities to use nutrients more efficiently and improve water quality, through better timing and placement of nutrients by potentially reducing losses by deep percolation and erosion. While limited, the evidence available generally supports the contention that alternative irrigation technologies can reduce the off-site effects of irrigated agriculture. However, there is a need to investigate how nutrients move through the soil matrix under these alternative irrigation methods. With the passing of the Nutrient Management Act, 2002, a set of new standards aimed at managing nutrient-containing materials by farmers, municipalities and others in the business will be implemented. Given the high potential impact that nutrient management planning will have on the Ontario agriculture industry, there is a need to develop economically and environmentally sustainable nutrient management strategies. There is a need to determine nutrient and irrigation water requirements for sustainable production of agricultural crops grown in Ontario. This work will provide important baseline data for the development of such nutrient management plans.

4. Soil and Crop Management

Research investigating the effects of soil management practices on chemical, biological and physical soil quality as related to crop production and environmental stewardship.

Soil is a critically important element of sustainable agricultural production, functioning not only in food and fibre production but also in maintaining local, regional and global environmental quality. High quality soils are not only more productive but also play a major role in enhancing air and water quality. Soil management practices, such as tillage, cropping pattern, and fertilization influence soil, water, and air quality. Past soil

management for food and fibre production has taxed the resiliency of natural processes to maintain a balance of the cycling of energy and matter. Degradation of the soils productive capacity has occurred as a result of intensive agricultural production and resulting soil erosion, atmospheric pollution, cultivation and land clearing. Water quality is jeopardized by our choices in soil management and the consequent imbalance of C and N cycling in the soil. The present threat of global climate change and soil management issues dealing with carbon sequestration and the reduction of greenhouse gas emissions warrants a better understanding of the effects of soil management on soil processes.

Assessing soil quality and its impacts on productivity and the environment is complicated since research must consider the multiple functions of soil and integrate the physical, chemical and biological soil attributes that define soil function. However, to achieve the goals of high crop yields and quality with minimal environmental impact requires reliable research information that assesses the impact of management on soil quality and on soil use. In addition, the fundamental requirements of profitability and competitiveness must be incorporated into the overall soil management strategy.

5. Identification / Validation of Best Management Practices

Research directed towards the implementation, validation (including cost/benefit analysis) of Best Management Practices, as related to the other identified Priority Issues.

A "Best Management Practice" (BMP) is defined as a practical and affordable approach to conserving and utilizing in an environmentally responsible manner a farm's soil and water resources without sacrificing productivity. The agricultural community has been encouraged to use, and are using, different types of environmentally related BMPs to protect and improve surface and ground water resources on both a farm and watershed scale. Reduction of the entry of phosphorus, nitrogen, pesticides, pathogens and sediment into water resources has been the main focus of the BMPs. The development of nutrient management plans rely heavily on BMP's for criteria related to nutrient applications (both inorganic and organic sources) and crop management systems. While most BMPs are based on research findings, some have not been tested at various scales and the net effect of combinations of BMPs is unknown. Scaling problems will always be an issue, and until better scaling methodologies are developed, it will be difficult and risky to interpret BMP validation data at scales other than at which the information was collected. Effectiveness of combinations of BMPs is particularly important when one considers the consequences of the ratification of the Kyoto Agreement and current issues surrounding water quality and quantity. For example a set of BMPs that effectively minimizes nitrate leaching or soil erosion may promote greenhouse gas emissions.

Greater acceptance of BMPs by the agricultural community requires validation of the BMPs achieving the desired outcome (i.e. risk reduction), the cost/benefit analysis associated with the practice, and the effective communication of this information to the producer.

6. Biosolid / Waste Application and Treatment

Research investigating biosolid/waste treatment and management methods resulting in the reduction of contaminant transport off-site while improving nutrient use efficiency and crop production.

Controversy surrounds the utilization of biosolids and other waste materials on agricultural lands. While many of the issues such as nutrient availability, potential soil, water and air contamination with biosolids and waste materials are similar to those with manure, there are considerable differences in the range of properties associated with the materials involved. Biosolid/waste materials have the additional stigma as being waste materials that are imported to and disposed of on agricultural lands, rather than a valuable source of nutrients and organic matter additions to the soil. Biosolids are known to improve soil physical, chemical, and biological characteristics and have the potential to enhance crop yields. At the same time, public health and environmental concerns regarding objectionable odours, chemical contaminants and pathogens present a challenge for the safe handling and application of these wastes materials. Concentrations of nutrients in these materials vary both over time and among treatment methods. Increased public concern over the odours, potential transmission of pathogens and nutrients into surface and ground water as well as into the food chain has generated interest in the use of biosolids that have been subjected to some form of treatment to reduce these problems. There is a need to investigate the effect of different management methods and treatments for these organic amendments on the control of odours, reducing the number of potential pathogens and maintaining their nutrient content for the production of agricultural crops grown in Ontario.

7. Rural Air Quality

Research addressing the interactions between agricultural practices and rural air quality.

The rural air quality issue is a double-edged sword, with air quality (pollution) impacting upon crop production, while agricultural practices may also affect air quality (usually odours from livestock operations, manure and biosolid applications). The past two growing seasons have been characterized by an increase incidence of "smog days", extending beyond the typical urban areas into the rural communities. Air pollution injury has been observed on susceptible crop species, and may have been a contributing factor to yield and quality reductions in these crops. The effect of air pollution on crops is an area that is not well understood and needs to be monitored.

Manure and biosolid odour problems have been the major air quality issue of the rural populace, leading to a large number of confrontations between agricultural and non-agricultural groups. As mentioned previously in Priorities Issues 1 and 6, research

regarding the management of organic sources of nutrients should include methods to minimize odour problems during storage and application.

8. Greenhouse Gas Emissions / Climate Change

Research assessing the manner in which agriculture can mitigate climate change, the impact of climate change on agriculture and the adaptation of agriculture to climate change.

Agriculture is undoubtedly one of the most sensitive sectors to climate change, but also highly amenable to intervention of climate change through the mitigation of greenhouse gas (GHG) emissions. Agriculture is a major source of nitrous oxide and methane emissions, although it can also serve as a potential sink for carbon dioxide. Assessment of the fluxes of these gases from various agricultural systems is required to truly understand the potential impact that alternative management strategies may have on total GHG emissions. Such an assessment would also involve the ability to model and scale results up from a farm to regional/ecozone or national scale.

The current trend in climate warming, whether attributable to GHG emissions or a natural phenomenon, may have significant impact on Ontario agriculture. Analysis of historic climatic data suggests that the period of time from the 1950-1980 actually represented a period of relatively unusual stable climate. The recent variations in weather within and between years experienced in the past decade or so may actually be more indicative of 'normal' weather conditions. Consequently, growing season lengths, precipitation (amount and distribution), and temperatures are more likely to increase in variability. These changes could bring about changes in the winter survivability of perennial plants and certain pests. As a result, production systems and practices must adapt to these greater extremes if large-scale crop failures are to be avoided. For example, hotter and drier growing season conditions may increase the need for irrigation and irrigation methods that improve water use efficiency.

STRATEGIC RESEARCH RECOMMENDATIONS

The following strategic research recommendations that were identified as having a high priority and are identified as to which Priority Issue(s) they address. The reader is referred to the 2002 report for a complete listing of high, medium and low priority recommendations. Additional new information included in recommendation H11 is underlined.

1. High Priority Strategic Research Recommendations

Note: These are listed in order of main PRIORITY ISSUE.

Recommendation H1: Nitrogen and Phosphorus Management of Manure and Biosolids to Minimize Losses and to Maximize Availability to Field and Horticultural Crops.

ISSUE: Manure Management, Nutrient Use Efficiency, Biosolid/Waste Application and Treatment

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Background:

In the past number of years nutrient management plans have attempted to match nutrients from land applied organic materials to meet crop needs. The results have reduced over application of nutrients and reduced the risk of environmental contamination, mostly to surface water. However, there is much "fine-tuning" required in better understanding the nitrogen and phosphorus cycles in the organic materials, as well as how these cycles change once the material is applied to the soil under various application systems and over a number of years. How does the nitrogen cycle and availability of nitrogen change when manure is injected versus surface applied, for example? With phosphorus, the concern in Ontario has been largely from a surface water contamination perspective, and a P-Index was created to assess the risk of P movement based primarily on the risk of soil movement. Verification of the P-index,

through field studies is required to ensure that the major mechanism of P movement to surface waters has been adequately characterized and the risk of P contamination of water suitably reduced. Under Ontario conditions, what are the mechanisms of phosphorus movement? For example, is preferential flow the main pathway for phosphorus movement to tiles?

Part 1: Research is required in nitrogen management of manure and biosolids under various handling systems. Improving prediction of mineralization of liquid and solid materials, as well as the prediction of risk of N_2O production from the nitrification process (especially in conditions where excess ammonium is added to the soil) would help to time manure and biosolids applications to maximize utilization and decrease loss especially in groundwater recharge areas and sensitive groundwater area (i.e. shallow to bedrock soils). From a cropping perspective, additional research is required in determining how to improve nitrogen utilization considering timing, placement, use of cover crops and existing soil organic matter content, especially in horticultural crop production systems.

Part 2: There is a need for research to determine the effectiveness of cover crops for nutrient absorption and retention in fields that receive manure. Research can also be conducted to determine the rate that nutrients are released from the cover crops for subsequent crops. The research should include the optimum types of cover crops for application of manure at different times of the growing season and different types of manure. This research is needed to improve nutrient management planning.

Part 3: Research is required to better understand, and manage through BMPs, the mechanisms of phosphorus movement in Ontario soil conditions, especially as phosphorus soil tests increase from continuous manure application. In addition, the crop availability of phosphorus from biosolids undergoing different treatments needs to be better understood.

The benefit of the above research would be that it would help to provide better prediction of nutrient application options in nutrient management planning for manure and biosolids. Research would also potentially help identify which (sometimes contradictory) BMP would be best under specific field/soil/farm conditions.

Recommendation H2: **Effect on Nutrient Availability, Pathogen Reduction, Greenhouse Gas Emissions and Economics of Various Treatment Systems for Liquid and Solid Manure and Biosolids**

ISSUE: Manure Management, Nutrient Use Efficiency, Biosolid/Waste Application and Treatment

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
 Field Crops Research and Services Committee
 Horticultural Crops Research and Services Committee
 Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
 Agriculture and Agri-Food Canada
 University of Guelph
 Agricultural Research Institute of Ontario
 Canadian Agri-Food Research Council

Background:

Manure and Biosolids are under increasing scrutiny from society due to potential nutrient contamination and pathogen contamination of water sources. Increasing interest in alternative manure treatment systems is a result of increased public pressure combined with large liquid volumes and limited land base (in some areas of Ontario) for more manure/biosolid application. Liquid systems including anaerobic digesters, aerobic systems, and electrolysis of manure are being discussed and tried to evaluate pathogen, odour and nitrogen reduction potential. Solid systems including proper composting, sterilization and complete drying of manure are also being evaluated for odour, volume and pathogen reduction. From a mechanical point of view these systems can work.

Research is required to determine the effect of treatment systems on nutrient content and availability, pathogen reduction, as well as on various greenhouse gas emissions and odours. Although not as critical, the economics of these systems must also be considered (for example what is the cost of treatment versus the improvement in pathogen/nutrient/lack of greenhouse gas emissions). The economics play an important role in determining how economic instruments can be designed to evaluate the benefits (i.e. how much society could/should pay).

This research would benefit both livestock producers and rural landowners. Livestock producers with large liquid manure systems, especially in areas where land base is limited could reduce land base requirements for manure application. Manure/biosolid applicators and rural landowners would have decreased risk from nutrient and pathogen

contamination as well as reduced odours. A by-product of some treatment processes could also lead to the development of "green energy".

Recommendation H3: Manure Application Systems: Timing, Nutrient Loading and Tillage Interactions.

ISSUE: Manure Management, Nutrient Use Efficiency, Soil and Crop Management, Biosolid/Waste Application and Treatment

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Background:

Current research in Ontario addresses many issues associated with manure application, however, some areas of research require much more work. The timing of manure application in relation to the availability of nutrients from the manure is not completely understood. Manure is applied on frozen ground. The fate of the nutrients from manure applied on frozen soils in the environment has not been fully studied. Manure is applied at all other times of the growing season and the fate of nutrients in that manure is often not known.

Another manure application issue is nutrient loading. In some instances manure is applied at extremely high rates over many years. How much manure can be reasonably applied without losses of nutrients from the field to the environment? How can we best keep those nutrients in the soil that the manure was applied to? These are questions for which we need answers.

Reducing tillage may reduce the potential for runoff of manure and nutrient losses from fields. Research with manure application in reduced tillage conditions should be conducted to determine the optimum methods, rates and timing of applied manure in reduced tillage systems.

Recommendation H4: Nutrient management planning for horticultural crops

ISSUE: Nutrient Use Efficiency

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Horticultural Crops Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

There has been minimal research in the past for calibration to determine fertilizer recommendations for horticultural crops grown on Ontario soils. Research is needed to establish "best" fertilizer practices (rates, timing, application methods, fertigation, macro- and micro- nutrients and formulations) for horticultural crops. This information is crucial to enhance the applicability of nutrient management plans to horticultural crop production. Research is needed to evaluate the effectiveness of these nutrients on the yield and especially the quality of horticultural crops.

Recommendation H5: New Nitrogen Recommendation Systems for Crops.

ISSUE: Nutrient Use Efficiency

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

Some areas of a field require no nitrogen, while other areas within a field require high rates of nitrogen, for optimum growth. This research recommendation is for creating methods of accurately predicting nitrogen requirements in different areas of fields for crops that require nitrogen. Current methods of predicting nitrogen needs within a field do not adequately account for nitrogen variation across a field. On-farm verification of recommended nitrogen fertilizer application rates should be included in the nitrogen recommendations system.

Recommendation H6: Nitrate N test for Horticultural Crops

ISSUE: Nutrient Use Efficiency

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Horticultural Crops Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

Research and field trials are necessary to evaluate and calibrate a nitrate-nitrogen test for horticultural crops, particularly in muck (organic) soils and a pre-sidedress nitrogen test for sweet corn. As well, field demonstrations are needed to evaluate quick test technology for nitrates in both mineral and muck soils. This technology is being used in other parts of the world (particularly North America) but has not been well studied in Ontario.

Recommendation H7: Standard methods for manure analysis

ISSUE: Nutrient Use Efficiency

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES:

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

Standard Methods for manure analysis (Total N, P, K, NH₄-N, Dry Matter) would be developed for Ontario laboratories. This would be accomplished in stages: First, survey labs for methods currently being used, and assessing differences and similarities. Second, complete a literature review to assess appropriateness of current methods. Third, exchange samples among labs to compare results from different labs.

Recommendation H8: Establish a Watershed Nutrient Loading Capacity and Identify Sources and Pathways of Contamination.

ISSUE: Water Management

SOURCE: Ontario Water Management Research and Services Committee
Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

Background:

Policy should be established that outlines the total nutrient loading capacity of a watershed. If the loading capacity is exceeded then the amount of reduction necessary to achieve appropriate levels must be quantified. This policy would assist municipalities in developing a consistent and fair mechanism to aid in land use decisions. Inherent in the development of such policy is the need to characterize the transport pathways of phosphorus, nitrogen and pathogens over the soil surface and through the soil matrix to tile drains and the water table.

Part 1: From a monitoring perspective, research is required to identify surface water stress indicators related to excess nutrient load, as well as benchmark standards for tile water quality. Issues pertaining to scale of operation and losses (risk and amount) of contaminants are also of importance. Reliable methods are needed for identifying sources of contamination by pathogens and bacteria (e.g. DNA fingerprinting).

Part 2: From a predictive and modeling perspective research is required to identify pathways of pathogen, nutrient, pesticide and other contaminant and transport to groundwater. Information is also needed regarding the scale of farming operation versus risk and amount of leaching and runoff losses of contaminants.

Recommendation H9: Development and Establishment of a Sustainable Water Extraction and Sharing Policy, and a Monitoring System to Ensure Future Supplies are Protected.

ISSUE: Water Management

SOURCE: Ontario Water Management Research and Services Committee
Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

Background:

The quantity of groundwater and surface water supplies could be at risk in the future, especially if growth continues at the current rate and climatic changes bring more dry years. A sustainable water extraction policy and an adequate monitoring system are required to ensure that future supplies are available. The policy would assist planners in resolving issues in water use/overuse conflicts and could be used as a decision-making tool when assessing applications to take water. Inherent in this policy is the need to define or identify the water needs of the natural environment. One fundamental issue to address is what should be the main source of potable water (i.e. surface or groundwater). Ongoing research in efficient irrigation systems, timing of irrigations and reducing environmental impact from irrigation practices need continued support and development to promote the efficient use of this potentially limited resource.

Recommendation H10: Development of Best Management Practices (BMPs) to Deal With Pathogens and Other Contaminants (Bioaerosols, Endocrine Disrupters, Antibiotics, Pharmaceuticals, Heavy Metals etc) in Manures and Biosolids

ISSUE: Identification/Validation of Best Management Practices
Manure Management
Biosolid/Waste Application and Treatment

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

In the development of nutrient management standards for application of manure and biosolids, the different materials are often compared from a nutrient equivalent. The media attention from pathogen contamination of water from organic materials has put into question how these materials should be compared from a risk perspective. Other contaminants being questioned (and measured?) in organic materials include all pathogens (not just indicators such as coliform or ecoli), endocrine disrupters, antibiotics, pharmaceuticals, and bioaerosols, etc.

Research is required to better answer some of the following questions around contaminants in organic materials.

Part 1: Research is required to better understand the various pathogens in organic materials. For example: How can we limit the survival of pathogens applied to land, and prevent pathogen transport in preferential flow channels? How can we separate the sources of pathogens in surface water bodies to effect implementation of BMPs? What are the maximum daily loads of contaminants that we can allow into our water resources, and have a sustainable program for the use of the resources? And finally, what actions do we need to prevent the cycling of pathogens between humans and animals?

Part 2: Research is required to better understand the impacts so that BMPs can be developed for applying waste on agricultural land when the waste contains antibiotics, hormonally active compounds, bioaerosols or other pharmaceuticals.

Benefits of this research would increase the confidence of Ontario residents that the application of organic materials is safe from both a nutrient and "other contaminant" point of view. It would also help to determine treatment and or application measures for materials of "different qualities".

Recommendation H11: Best Management Practices Economic and Environmental Cost-Benefit Analysis

ISSUE: Identification/Validation of Best Management Practices
Manure Management
Nutrient Use Efficiency

SOURCE: Ontario Soil Management Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario

Background:

Rural water quality "Best Management Practices", including alternative livestock manure storage, nutrient management plans, partial, seasonal and complete livestock access restriction, innovative rural septic beds, urban stormwater runoff controls, riparian buffer strips, vegetative filter strips, wetlands and other practices all vary in terms of cost and the anticipated water quality benefit. A thorough assessment of anticipated benefit and cost would provide some guidance in prioritizing activities for the source protection plans proposed in the Walkerton Report. The end product should be an analysis of options based on \$/kg phosphorus or \$/E.coli bacteria.

Development and testing of BMPs for liquid and solid manure application timing and methods in terms of pathogen and nutrient fate is required. Alternatives to land application of manure and condensing of liquid manure such as use of organic bedding material and composting need to be investigated. Pilot-scale testing of new methods of managing/utilizing liquid manure such as composting, condensing, pre-treatments, energy from manure (e.g. methane digestion) will be required to ensure suitable success with the technology at the farm level. In addition, the effectiveness of different types of injection/incorporation equipment and new controlled rate application technologies (flow meters with injection booms) vs. current methods in terms of crop response and environmental risk (leaching losses of nutrients, pathogens, feed supplements (growth hormones, antibiotics)) need to be assessed as well as methods to utilize manure under no-till crop production systems. Environmental impacts and relative costs of dead stock disposal options (burial, composting and incineration) need to be evaluated.

Research is also needed to quantify the leaching losses of nitrogen and transport of pathogens from septic systems to groundwater, and the efficacy of innovative designs for rural septic systems needs to be assessed.

Recommendation H12: To continue to support the measurement and modelling of greenhouse gases emissions, quantify emissions of these gases from agricultural activities and to expand the work on atmospheric transport of gases.

ISSUE: Rural Air Quality and Greenhouse Gas Emissions

SOURCE: Ontario Agrometeorology Research and Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Horticultural Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture and Food
Agriculture and Agri-Food Canada
University of Guelph
Agricultural Research Institute of Ontario
Environment Canada
Canadian Agri-Food Research Council

Background:

Part 1: The recent ratification of the Kyoto Protocol has raised many questions as to the role that agriculture will ultimately play in helping Canada meet its targeted emissions. Research is still required on the overall impact of management practices on carbon sequestration, as well as carbon dioxide and nitrous oxide emissions in order to truly assess the net impact of management practices and crop production levels on greenhouse gas emissions within a farming system, especially those utilizing nitrogen and organic materials (manures, biosolids etc.).

Part 2: Research is also required in the area of diffusion/dispersion of various gasses (e.g. odours) in agricultural situations for development of practices and guidelines to minimize conflicts between agricultural producers and the rural community.

NEW RESEARCH RECOMMENDATIONS - 2003

Given that the previous year was a strategic planning year, most of the subcommittees did not bring forth new research recommendations in 2003. The following research recommendations were identified by the OWMRSC.

New Recommendation 2003-1: Develop Contingency Plans for Natural Disasters

Flooding and fire can be devastating to rural dwellers. To our knowledge there are no protocols for protecting on-farm water resources from such disasters. The development of contingency plans for well-head and local stream water protection would be beneficial to emergency response teams, municipal governments and of course landowners. Emergency preparedness planning, which is commonly undertaken for industrial sites, has not generally been done for protecting rural water resources to our knowledge.

Suggested Research Topics:

- document current response protocols for flooding and fires in terms of protection of water resources (surface water and groundwater) in municipalities outside of Ontario.
- develop system design criteria for emergency preparedness plans for protecting water resources from disasters such as fire and flooding.
- assemble a geographic distribution of current surface water and shallow groundwater quality to determine changes in water quality due to a disaster.

New Recommendation 2003-2: Couple Risk Assessment and Water Quality Impacts.

Environmental risk assessment is an important component in analyzing alternative agricultural management practices, proposed land use changes, impacts of new livestock operations, etc. A key factor in any risk assessment is the potential impact on surface and ground water quality. More research is required on clearly establishing the relationship between risk and water quality in a quantitative, consistent and defensible manner.

Suggested Research Topics:

- integrate risk assessment calculations directly with enhancement or degradation of water quality.
- develop quantitative, standard approaches to determine risk.
- use GIS to create maps of relative risk of harming surface and ground water quality for agricultural activities such as manure spreading and municipal biosolid application (could be integrated with one of the suggested research topics in Recommendation 4: develop criteria based on sound scientific and risk management principles to designate sensitive and vulnerable areas).

SERVICE RECOMMENDATIONS - 2003

Specific service recommendations brought forward by the various subcommittees can be found in the subcommittee reports in the Appendix. The following service recommendations encompass many of the issues raised by the subcommittees and members of the OSWARSC at the 2003 meeting.

The major theme of service recommendations was focussed around the issue of database creation, maintenance and accessibility. The committee is keenly aware that these recommendations have been brought forward in the past; that some progress has been made in some areas; and that the importance of such data basis is increasing given the current environmental issues facing Ontario agriculture.

Service Recommendation #1: Ontario Soil Database

Soil surveys in Ontario should continue to be upgraded, and where necessarily redone to improve decision making by Ontario citizens (e.g. development of Nutrient Management Plans). There are gaps in the province's soil survey information that need to be filled. These include counties for which no known report can be found (e.g. Brant County) or reports which are old and produced prior to the development of current classification systems. Information from these surveys is being used in the regulation of nutrient applications. Currently there is no continuity in soil maps from one county to another (i.e. the soil types and boundaries do not line up from one county to the next). Clearly, if soil surveys are to be used for regulatory purposes there needs to be continuity across county lines. Soil mapping should be conducted using current mapping and classification technologies, and such maps should be readily available for use.

Service Recommendation #2: Ontario Water Database

It is difficult to assess the impact of an industry on water resources without a baseline of information. If we wish to demonstrate and improvement or maintenance of water quality in the province, then it is imperative that a provincial database is designed and maintained that includes information on current and past groundwater and surface water quality and quantity. Included in this recommendation is the need for additional hydrological information and data that is required to run computer models of water flow and contaminant transport. Accessibility of this information through a web-based design is extremely important.

Service Recommendation #3: Ontario Weather Database

As has been noted in several previous reports, collection of and accessibility to weather data for Ontario province has greatly diminished with recent changes in Environment Canada (discontinuation of agricultural web page, reduction in volunteer observer

program) and Agriculture and Agri-Food Canada (restructuring of agro-climate network which is now hosted in Western Canada). The Ontario Weather Network, operated by Ridgetown College, University of Guelph has attempted to respond to these changes but is limited by the extent to which private funds can be obtained to run the program. Reliable and local weather data is important for modelling/predicting disease and pest pressures in crops, as well as establishing pesticide and irrigation schedules. Such information could also be useful in the determination of 'safe times' (i.e. low risk of runoff and/or leaching) for the application of nutrient containing materials to farms lands.

Service Recommendation #4: Databases and Data Repositories for Ontario Research

The recent exercise of generating a Nutrient Management Plan based on relevant and where possible local research highlighted the need for a repository of Ontario soil/water based research. Existing data from nutrient studies (crop yields and nutrient uptake) and soil and water quality experiments should be centralized in databases that are accessible to researchers etc. that would allow for easy integration of new knowledge with existing knowledge. This data base would not simply be a listing of experiments, but would contain the actual data and interpretations. Ideally the databases would be web based and able to be sorted by factors such as county, soil type, date, etc.

Service Recommendation #5: Dissemination of Knowledge

Several service recommendations were directed towards the continued technology transfer from researchers and OMAF staff to producers. These include:

- 1) Existing information on precision agriculture should be extended to farmers on an as-required basis.
- 2) Manure management: Existing information should be disseminated to as great an extent as possible. Demonstrations of manure best management practices are needed. OMAF is encouraged to continue its publication of FactSheet on this topic as well as the N index.
- 3) Increasing the awareness of the importance of soil quality in crop production. Through information sessions, like the Soil Quality Workshop, displays at the Ontario Farm Show and publications. OMAF is encouraged to complete the Buffer Strip BMP and soil management CD.
- 4) Educate user of soil test the limitations of interpretation of the soil N test and address issues where MOE requires N test even though no crops are being grown for which the N test is recommended.

ONTARIO SOIL, WATER AND AIR RESEARCH AND SERVICES COMMITTEE MEMBERSHIP 2003

Ivan O'Halloran (Chair) Ridgetown College, Ridgetown	Keith Reid (past-Chair) OMAF, Stratford
Craig Drury (Chair-elect) AAFC –GPCRC, Harrow	Adam Hayes (OSMRSC Chair) OMAF, Ridgetown
Gary Parkin (OWMRSC Chair) University of Guelph, Guelph	Jon Warland (OARSC representative) University of Guelph, Guelph
Ted Briggs U.T.R.C.A.	Paul Brine OMAF, Guelph
Murray Cochrane O.S.C.I.A.	Mary Jane Conboy OFA
Bill Curnoe Kemptville College, Kemptville	Chris Duke OMAF, Guelph
Michael Goss University of Guelph, Guelph	Ken Hough, Rhonda Alger University Guelph, Guelph
Ian Jarvis, Clarke Topp, Neil McLaughlin AAFC – ECORC, Ottawa	Pamela Joosee OMAF, Guelph
Brent Kennedy OMAF, Guelph	Don McCabe O.C.P.A. and O.F.C.R.C.
Michael Payne OMAF, Stratford	John Rowsell New Liskeard Agric. Res. Strn., New Liskeard
Ed Topp AAFC, London	Gilbert Vansteelandt Ag Care

APPENDIX

1. Ontario Soil Management Research and Services Committee Report
2. Ontario Water Management Research and Services Committee Report
3. Ontario Agrometeorology Research and Services Committee Report*

* The Ontario Agrometeorology Research and Services Committee Report is simply a compilation of material submitted by various members of that committee. Unfortunately the OARSC did not meet in 2003, and is currently without a Chair. As such, OSWARSC dealt with the recommendations brought forward with the understanding that the report was limited in that it was not the outcome of a full representation of the committee. The OSWARSC is working with OARSC to revive the committee membership and/or discuss alternative means to address the research and service issues currently under this committee mandate.

**ONTARIO SOIL MANAGEMENT RESEARCH AND
SERVICES COMMITTEE**

2003 REPORT TO

**ONTARIO SOIL, WATER AND AIR RESEARCH AND
SERVICES COMMITTEE**

MEETING SUMMARY

The annual meeting of the Ontario Soil Management Research and Services Committee was held on June 10-11, 2003 at the Simcoe OMAF office. The chairs of the field crops, horticultural crops, waste utilization, soil test lab, soil and water quality and the tobacco subcommittees outlined research progress, research and services priorities and changes to OMAF publications.

Nutrient management continues to be an issue of concern for the committee. To improve the committee's ability to address this issue the committee added a representative from the livestock sector. The horticulture crops subcommittee continues to have concerns about the lack of research in many horticulture crops, although the timelines have been lengthened giving more time for research. The waste utilization subcommittee has concerns about the limitations on the application of biosolids under the nutrient management act and the impact it will have on the industry. They are also concerned about the fate of pathogens in manure applied to shallow to bedrock soils. This past May the Canadian Fertilizer Institute, in partnership with industry and commodity groups, launched a Canadian Crop Nutrients Council to promote science based BMPs.

OMAF has requested money to support a Nutrient Management Research Strategy. The strategy would identify and prioritize research needs, coordinate with other programs and follow through to ensure research results are incorporated into recommendations and regulations. OMAF in cooperation with the University of Guelph, Agriculture and Agri-Food Canada and industry are organizing a Nitrogen Forum. The intent is to bring together researchers in the area of nitrogen management to work towards better recommendations in the future.

Water quality concerns continue but the issue of water quantity is becoming critical in some areas of the province.

There is a need for research into best management practices for greenhouse gas mitigation in light of the recent ratification of the Kyoto accord by the federal government.

Service Recommendations

1. Soil Survey. Soil surveys in Ontario should continue to be upgraded and redone to improve decision making by Ontario citizens (e.g. Nutrient Management Plans). There are gaps in the soil survey information of the province, which should be filled. For example, there is no known copy of the Brant county report. Other reports are old and were produced before current soil classification systems were developed. **Currently there is no continuity in**

soil maps from one county to another. The soil types and boundaries do not line up from one county to the next. If soil surveys are to be used for regulatory work, there should be continuity across county lines and current mapping and classification technologies should be used. -Soil and Water Quality Subcommittee

Action: Referred to OMAF and AAFC.

1. Databases and Data Repositories. Existing data from soil and water quality experiments should be centralized in databases which are accessible to researchers to: i) allow for easy integration of new knowledge with existing knowledge; and ii) allow for upgrading of research or service recommendations as warranted. This database would not be a simple listing of experiments, but would contain the actual data and interpretations. Ideally the databases would be web based and be able to be sorted by factors such as county, soil type and date of research. -Soil and Water Quality Subcommittee

Action: Referred to OMAF, AAFC and U of G to decide who would fund, store, manage and maintain the databases.

2. Precision Agriculture. Existing information should be extended to farmers on an as-requested basis. -Soil and Water Quality Subcommittee

Action: Referred to OMAF, and U. of G.

3. Manure Management. Existing information should be disseminated to as great an extent as possible. Demonstrations of manure best management practices are needed. -Soil and Water Quality Subcommittee

Action: Referred to OMAF, AAFC and U of G.

4. Soil Management. Increase the awareness of the importance of soil quality in crop production. Information sessions such as the soil quality workshop and displays at the Ontario farm show should be continued. The committee encourages OMAFRA to complete the Buffer Strip BMP and the soil management CD. -Soil and Water Quality Subcommittee

Action: Referred to OMAF, and AAFC.

5. Factsheets. The committee recommends that OMAF continue to produce factsheets on manure management and the N index. -Soil and Water Quality Subcommittee

Action: Referred to OMAF publication committee

6. Educate users of soil tests of the limitations of interpretation of the soil nitrate tests e.g. MOE requiring nitrate samples for biosolid applications, to areas where no crops that have fertilizer recommendations are grown; dealers and growers expecting results on same day as samples shipped. -Soil Test Lab Subcommittee

Action: Referred to OMAF, MOE and back to the soil test lab subcommittee

7. Financial incentives (tax breaks) for implementing manure treatment technologies. –Waste Utilization Subcommittee

Action: Referred to Resources Management, OMAF

8. Groundwater studies and capture zones- that any restrictions are consistent across municipalities across Ontario. –Waste Utilization Subcommittee

Action: Referred to MOE

9. Identify which horticultural crops will be most impacted by using an N-Index as an approach to fertilization through the development of crop profiles, N-index scenarios and field demonstrations, nitrogen-phosphorus uptake vs. nitrogen-phosphorus removal. – Horticulture Crops Subcommittee

Action: Referred to OMAF and U. of G.

10. Determine base line values of nitrate nitrogen, phosphorus and human related pathogens in greenhouse and container nursery leachate, and horticultural washwater. –Horticulture Crops Subcommittee

Action: Referred to OMAF and U. of G.

11. A database needs to be developed supporting the following identified gaps in information needed for the NMA: yield data numbers, –Horticulture Crops Subcommittee

Action: Referred to OMAF

12. The implementation, adaptability and practicality of new technologies such as chlorophyll meters, petiole analysis, soil quick tests, pre-sidedress nitrogen test, and GPS need to be evaluated at a practical producer level as tools to adjust nitrogen rated in season. – Horticulture Crops Subcommittee

Action: Referred to OMAF and U. of G.

13. OMAF tobacco extension should provide growers with one-on-one consultation when required. – Tobacco Subcommittee

Action: Referred to OMAF.

14. OMAF continue adding production information related to tobacco on the OMAF website. - Tobacco Subcommittee

Action: Referred to OMAF

15. OMAF should prepare an information package on best management practices for producing tobacco seedlings in trays. – Tobacco Subcommittee

Action: Referred to OMAF

2003 ONTARIO SOIL MANAGEMENT RESEARCH AND SERVICES COMMITTEE

Annual Meeting - Minutes

The annual meeting of the Ontario Soil Management Research and Services Committee was held on June 10-11 at the Simcoe OMAF office.

Attendance:

Adam Hayes	Ron Beyaert	Bill Cumoe
John Rowsell	David Kroetsch	Sid Ryzebol
Godfried Amankwa	Christine Brown	Pamela Joosse
Ian McLachlin	Anne Verhallen	Doug Young
Christoph Kessel	Ivan O'Halloran	Keith Reid
Paul Brine, IRMB	Craig Drury	Brent Kennedy
John Lauzon	Tom Bruulsema	

Regrets: Dale Cowan, Marius Marsh, Maria Derkacz, John Lauzon (Tuesday)
Craig Drury (Tuesday), Ed Gregorich, Dan Reynolds, Chris Attema, Tiequan Zhang, Brent Kennedy (Wednesday), Christine Brown (Wednesday)

Adoption of 2002 Annual Meeting Minutes: (O'Halloran, Young). Carried.

Adoption of Special Meeting Minutes: (Kroetsch, Ryzebol). Carried

Correction to minutes: add Tom Bruulsema to list of regrets for meeting. He did not receive the email notification.

Membership Change

Motion to add representation from the livestock sector (**Cumoe, Ryzebol**). **Carried**.
OFAC was contacted, and they have named Chris Attema as the representative, and John Maaskant as the alternate.

Sub-Committee Reports:

Field Crops - Doug Young
Written report attached.

Motion to change the soil test rating descriptions from description of levels to a probability of response. (**Young, Rowsell**) **Defeated**

Amendment to change the heading of the table to "Probability of positive response", and to add this column to the existing table rather than replacing the table. (**Young, Bruulsema**) **Defeated**

Tom B. trusts the OMAF agronomists to "do it right".

Motion to strike an ad hoc committee to develop options for incorporating the concepts of crop response into the Ontario recommendations **(Young, Brown). Carried.**
This committee will have to link the current with the proposed tables, incorporating the environmental as well as agronomic concerns.

Committee membership:

Doug Young (chair), Christoph Kessel, Ian McLachlin, Keith Reid, Tom Bruulsema

Report by email to committee by early September.

Resolution from Field crop Subcommittee regarding limits in NMAN program **(Young, no seconder) Motion died.**

Motion to accept report: (Young, Beyaert) Carried.

Horticultural Crops – Christoph Kessel

Written report attached.

Report was prepared based on understanding of Nutrient Management regulations prior to March 21 announcement. Following that announcement, the timelines for implementation of the regulations have been extended considerably, but the importance of addressing the issues raised in the draft regulations remains.

Motion to accept report: (Kessel, Brown) Carried

Waste Utilization Subcommittee – Christine Brown

Written report attached.

Concerns were raised about the limitations on the application of biosolids under the nutrient management act, and the impact that will have on the industry. Concerns were also raised regarding how to handle septage during the phase-in of the ban on land application of untreated septage.

Motion to accept report: (Brown, Kessel). Carried.

Soil Test Lab Subcommittee – Ian McLachlin

Written report attached.

Manure analysis is the main issue at present. Sampling is a larger source of variation in manure samples than the analytical technique, but this is beyond the control of the labs. Within the labs, one of the potential sources of variation that has been identified is the impact of ammonia volatilization from manure samples during drying, and ways to overcome this.

Motion to accept report: (McLachlin, Beyaert). Carried

Soil & Water Quality Subcommittee – Doug Young (for Dan Reynolds)
Written report attached.

Committee noted that much more emphasis has been placed on water quality than on water quantity, but the demand for irrigation water has been increasing and impacting surface water.

Also noted that there are concerns regarding the disposal of spent growing media (Rock Wool) from greenhouses.

Motion to accept report: (Young, Amankwa). Carried.

Tobacco Subcommittee Report – Godfried, Amankwa
Written report attached.

Note that the Tobacco Specialist position has been filled for a 6-month period, after which time the position will be filled with a permanent position.

The Ontario Flue-Cured Tobacco Marketing Board has contracted with Norm Shiedow to provide the one-on-one consultation with growers.

Motion to accept report: (Amankwa, Young)

Update on Resources Management and Environment Program – Paul Brine
This program has just completed its four-year strategic review.

The revised program has identified ten issues to focus on over the next four years (down from 15 issues in the previous period)

Nutrient management portion of the program (roughly 50%) has been funded on a one or two year basis, to allow some flexibility as requirements for the nutrient management regulations become clearer.

List of all projects funded under past program attached.

New Directions projects have been approved, and the projects will be posted on the OMAF website as soon as the contracts are signed.

Discussion around the availability of research results. Paul indicated that IRMB couldn't release the final reports that they receive, because they are received on a confidential basis because of intellectual property rights. Any data required by this committee should be requested directly from the researcher.

Update on Nutrient Management Regulations – Keith Reid

The Nutrient Management Act was passed on June 27, 2002. The regulations have been in development since that time, and draft regulations were released for public consultation on November 30, 2002. Final regulations are being prepared for gazetting by the end of June.

(After-note: Ontario Regulation 267/03 was filed on June 30, 2003, for implementation on September 30, 2003.)

Nutrient Management Research Strategy – Pamela Joosse

Money has been requested to support a Nutrient Management Research Strategy. Components of this strategy include identifying and prioritizing research needs, co-ordinating with other research programs, and following through to ensure research results are incorporated into recommendations and regulations.

Other research programs include OMAF/U of G Partnership, AAFC, and Walkerton Legacy Trust.

Justification for the strategy has to be submitted to Management Board by fall of this year.

Tour of AAFC Research Station at Delhi.

Learned about Bonnie Ball-Coehlo's work with manure rates and application technology, and on-going work on drip irrigation for cucumbers, rotation effects on soil N and C, and emerging crops (sweet potatoes, ginseng, stevia, etc.)

STATION REPORTS:**Kemptville**

Some downsizing of the college due to the OMAF/U of G contract. No direct impact on the soils area, but some loss in the cropping area, which has an indirect effect. Report attached on two projects at Kemptville: paper mill biosolids, and impact of incorrect tillage timing.

Ridgetown

Limited work ongoing on tillage and crop rotations, hort crops (Zandstra), site specific ag and variable rate N applications, and P availability from swine manure with phytase or enviropig manure (O'Halloran)

New Liskeard

Sheep flock has been disbanded. Thunder Bay research station has been closed, and Gord Schiefele laid off. Only stations remaining in Northern Ontario are at New Liskeard and Emo. John is re-visiting the canola N recommendations, in light of higher

yielding varieties, incorporating both yield and quality aspects. Also working on hybrid poplar production methods, paper mill biosolids as mulch for weed control and low trajectory liquid manure application systems.

ECORC

Report attached. Re-organization of AAFC research branch means that reports should be moving to themes rather than geographic locations.

Harrow

Presently, there are six soils scientists at Harrow and one at Woodstock. Report attached. Two additional studies: closed loop water management systems, with tile water retained in a pond that can be re-used later in the season for sub-irrigation. Also, timing of nutrient release from organic materials.

Preliminary results from a study of handling methods of soil samples for nitrate and ammonium would indicate that both freezing and air drying can have an impact on the analytical results, particularly for ammonium. Full report will be presented to the committee when complete.

INDUSTRY REPORTS:

OABA/PPI

Report attached.

Fertiliser is in its sixth year of marginal to negative profitability. Lack of strength in the industry is being reflected in reduced money available for research.

This past May, CFI in partnership with industry and commodity groups, has launched a Canadian Crop Nutrients Council, to promote science based BMPs.

Changes in Research and Service Priorities:

Tobacco – same list of priorities as last year. Work is going on with calcium effects on leaf quality, and the use of millet rather than rye as a rotation crop for nematode control.

Service – Improvements in N recommendations for tobacco will be written up for submission to the subcommittee next spring (Amankwa, Reid, Dano, Kessel)

Soil & Water Quality – no change in research priorities.

Service Priorities –

- Continuity of soil series across county boundaries is very poor, and matching of databases need to be done to correct this problem. (David Kroetsch indicated that AAFC, with LIO, has a work plan prepared to address correlation between adjacent maps, but lack funds and people to carry out work plan)
- Databases need to be maintained so that data is not lost as people retire or move on to different positions.

- Precision Ag information needs to be more readily available to farmers
- Buffer Strip BMP and Soil Management CD need to get completed and released.

Motion to strongly request that the groups that have responsibility for soils information in both federal and provincial governments address the issue of correlation between soil maps in different jurisdictions (Young, Beyaert). Carried.
Contacts: AAFC – Soil Theme 110, study 2 (Lianne Dwyer, Wayne Lindwall)
LIO (David Cooper, Charles Lalonde, MNR?)

Soil Test Labs – Address priority 1 in attached report, with some new priorities regarding manure analysis.

Waste Utilization – No change in research recommendations.

Service recommendations – Standardization of reporting of analytical results, funding for manure management. (Report attached.)

Hort Crops – (report attached)

Field Crops – Carbon sequestration and C/N dynamics was removed as a separate recommendation, and incorporated as a subset of the other recommendations.

Changes in publications:

Publication 298: Denise Beaton is going to incorporate a section on Nutrient Management

Boron on Tobacco

Clarify procedure for growers to obtain an accredited soil test, and add Brookside Labs to lab list.

Motion to make changes to Publication 298 as recommended by Tobacco Subcommittee (Amankwa, Curnoe) Carried

Publication 811:

Changes to Critical leaf concentration of K in soybean leaf tissue

Data was presented from work by Tony Vyn on Ontario soybeans, as well as one site year from Doug Young at Woodslee.

Motion to Change the Critical Concentration and Maximum Normal Concentration in Table 4-15 to 2.0% and 3.0%, respectively (Bruulsema, Young) Carried.

Pg. 192, Pub. 811: Statement regarding boron deficiency in cereals is not correct. In Northern Ontario, there is an increased incidence of ergot where B is deficient. John will circulate data from AAFC regarding B deficiency in barley by email to the committee.

There are some errors in the Agronomy Guide on the Internet.

N-Index Triggers:

Motion to adjust N index triggers, as attached (Amankwa, Lauzon) Carried.

Note that listing of soil series for Eastern or Northern Ontario contains several errors with regards to the soil hydrologic group.

Provincial Soil:

David Kroetsch reported that he has been in discussions with Doug Aspinall and Eric Wilson regarding a provincial soil, and the criteria that could be used to choose such a soil. They should have a listing of potential soils to recommend for next year's meeting.

OSCIA report – Sid Ryzebol

OSCIA has been busy with three major projects: Greencover, Greenhouse Gas Mitigation Program, and EFP. Raised concerns about the progress on some of these because the bilateral agreement on the Agriculture Policy Framework has not been signed. Also noted that farmers are not going ahead with some nutrient management related projects because of uncertainty about availability of cost share dollars.

Election of Executive:

Not required for this year. Executive elected for 2-year term in 2002.

Nitrogen Forum – Pamela Joosse

A meeting is planned to bring together researchers in the area of nitrogen management, to work towards better nitrogen recommendations in the future. Four key areas of discussion: availability of soil organic N, Availability of manure organic N, Potential for N sequestration (cover crops, etc.), and Nitrogen partitioning. Two-day meeting is targeted for early December, probably in Guelph area. Members of OSMRSC will be invited.

Next Meeting:

Date: June 15-16, 2004

Location: New Liskeard

Motion to Adjourn at 11:35 am: (Beyaert). Carried.

OSMRSC MEMBERSHIP

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ONTARIO WATER MANAGEMENT RESEARCH & SERVICES COMMITTEE

Annual Meeting: Oct. 3, 2003.

Present:

Sandra Cooke, Grand River Conservation Authority
Elbert van Donkersgoed, Christian Farmers Federation
Stewart Sweeney, OMAF
Hugh Simpson, OMAF
Paul Brine, OMAF
Paul Sibley, Environmental Biology, University of Guelph
Ramesh Rudra, Engineering, University of Guelph
Gary Parkin, Land Resource Science, University of Guelph.

Meeting Agenda:

1. Introductions, 2. Review of 2002 Report, 3. Current Issues\Outline of 2003 Report 4. New Business\New Chair

Current Water Management Issues and Recommendations

The committee agreed that last year=s issues are still relevant and are therefore repeated below. The emerging water management research and service issues from this year are also given below in underlined print. Research issues are presented first with recommendations and suggested research topics summarized after each issue.

Research Issue A: Source Protection for Water Quality

Recommendation 1: Best Management Practices Economic and Environmental Cost-Benefit Analysis

Rural water quality ABest Management Practices@, including alternative livestock manure storage, nutrient management plans, partial, seasonal and complete livestock access restriction, innovative rural septic beds, urban stormwater runoff controls, riparian buffer strips, vegetative filter strips, wetlands, dead stock disposal, and other practices all vary in terms of cost and the anticipated water quality benefit.

A thorough assessment of anticipated benefit and cost would provide some guidance in prioritizing activities for the source protection plans proposed in the Walkerton Report. The end product should be an analysis of options based on \$/kg phosphorus or \$/E.coli bacteria.

Suggested Research Topics:

- testing of BMPs for liquid and solid manure application timing and methods in terms of pathogen and nutrient fate.
- investigate alternatives to land application of manure and condensing of liquid manure such as use of organic bedding material and composting.
- pilot-scale testing of new methods of managing\utilizing liquid manure such as composting, condensing, pre-treatments, energy from manure (eg. methane digestion).

- evaluate the effectiveness of different types of injection/incorporation equipment and new controlled rate application technologies (flow meters with injection booms) vs. current methods.
- leaching losses of feed supplements such as growth hormones, antibiotics, micro-nutrients, heavy metals.
- how to reconcile no-till crop production systems with recent recommendations to pre-till prior to manure application.
- quantify the leaching losses of nitrogen and transport of pathogens from septic systems to groundwater.
- investigate the efficacy of innovative designs.
- determine the environmental impacts and relative cost of dead stock disposal options including burial, composting, and incineration.

Recommendation 2: Establish a Watershed Nutrient Loading Capacity and Identify Sources of Contamination.

Policy should be established that outlines the total nutrient loading capacity of a watershed. If the loading capacity is exceeded then the amount of reduction necessary to achieve appropriate levels must be quantified. This policy would assist municipalities in developing a consistent and fair mechanism to assist with land use decisions.

Suggested Research Topics:

- identify surface water stress indicators related to excess nutrient load.
- identification of transport pathways of bacteria and other pathogens to groundwater.
- benchmark standards for tile water quality.
- identification of transport pathways of NPK fertilizers and pesticides.
- scale of farming operation versus amount of leaching and runoff losses of pathogens and nutrients.
- Is DNA Fingerprinting of source contaminates a reliable method to identify the source of contamination?

Recommendation 3: Establish Guidelines for Site Investigations and Continued Monitoring of Proposed Intensive Farming Operations and Biosolids Application.

Current guidelines for investigating potential contamination of groundwater and surface water from existing and proposed farming operations have not been firmly established. Approved methods and levels of intensity of investigations need to be developed. This information would provide farmers, municipalities, Provincial government bodies, etc. with tools to determine consistent and fair approaches for site investigations.

Suggested Research Topics:

- determine most cost-effective method to assess impacts of large-scale farming operations and biosolids application, investigate use of non-intrusive methods of soil and groundwater characterization; if monitoring wells are required, how many to install?; are existing databases adequate to determine potential impacts?
- determine minimum frequency of groundwater and surface water samplings required to monitor large-scale farming operations and biosolids application.

Recommendation 4: Municipal Well Head Protection and Groundwater Vulnerability Criteria

Municipalities across Ontario are compiling wellhead protection and groundwater vulnerability maps based on characteristics such as depth to bedrock, physiography, depth to water table, extent of aquifers and recharge rates. Designation of protected and vulnerable groundwater areas may have a significant impact on crop management and livestock agriculture.

Suggested Research Topics:

- develop criteria based on sound scientific and risk management principles to designate sensitive and vulnerable areas.
- rural development strategies to limit the number of new water wells and promote the use of innovative septic systems.
- develop fair land use designation tools.

Recommendation 5: Develop Contingency Plans for Natural Disasters

Flooding and fire can be devastating to rural dwellers. To our knowledge there are no protocols for protecting on-farm water resources from such disasters. The development of contingency plans for well-head and local stream water protection would be beneficial to emergency response teams, municipal governments and of course landowners. Emergency preparedness planning, which is commonly undertaken for industrial sites, has not generally been done for protecting rural water resources to our knowledge.

Suggested Research Topics:

- document current response protocols for flooding and fires in terms of protection of water resources (surface water and groundwater) in municipalities outside of Ontario.
- develop system design criteria for emergency preparedness plans for protecting water resources from disasters such as fire and flooding.

- assemble a geographic distribution of current surface water and shallow groundwater quality to determine changes in water quality due to a disaster.

Recommendation 6: Couple Risk Assessment and Water Quality Impacts.

Environmental risk assessment is an important component in analyzing alternative agricultural management practices, proposed land use changes, impacts of new livestock operations, etc. A key factor in any risk assessment is the potential impact on surface and ground water quality. More research is required on clearly establishing the relationship between risk and water quality in a quantitative, consistent and defensible manner.

Suggested Research Topics:

- integrate risk assessment calculations directly with enhancement or degradation of water quality.
- develop quantitative, standard approaches to determine risk.
- use GIS to create maps of relative risk of harming surface and ground water quality for agricultural activities such as manure spreading and municipal biosolid application (could be integrated with one of the suggested research topics in Recommendation 4: develop criteria based on sound scientific and risk management principles to designate sensitive and vulnerable areas).

Research Issue B: Source Protection for Water Quantity

Recommendation 7: Establish a Sustainable Water Extraction and Sharing Policy and Monitoring System to Ensure Future Supplies are Protected.

The quantity of groundwater and surface water supplies could be at risk in the future, especially if growth continues at the current rate and climatic changes bring more dry years. A sustainable water extraction policy and an adequate monitoring system are required to ensure that future supplies are available. The policy would assist planners in resolving issues in water use/overuse conflicts and could be used as a decision-making tool when assessing applications to take water.

Suggested Research Topics:

- should surface water or groundwater be the main sources of potable water?
- irrigation management for water conservation and reduction of leaching losses of fertilizer and pesticide, affordable alternative irrigation methods..
- defining water needs of the natural environment.

Recommendation 8: Quantify Current and Future Farm- and Watershed-Scale Hydrologic Water Cycles.

The water budget of a farm divides the received precipitation into four basic components: evapotranspiration, runoff, drainage, and soil storage. The amount of water that each component accounts for impacts not only water quantity but also water quality issues. There is a lack of information available for different regions of Ontario on how water is partitioned into the four basic components given above. This information could assist farmers, planners, etc. in resolving current and future land use issues, site investigations for contaminant source identification, and resolving conflicts in water sharing.

Suggested Research Topics:

- determine the potential impacts of climate change on water surplus and deficits in the future for different regions in Ontario using computer simulation models.
- quantify water pathways including runoff, tile drainage, deep drainage, and evapotranspiration, particularly in winter season.
- how to scale-up from field to farm to watershed.

Service Issue A. Database for Water Management.

- design and maintain a web-based database for hydrological information and data required to run computer models of water flow and contaminant transport in Ontario.

Service Issue B. Database for Current and Past Groundwater and Surface Water Quality and Quantity.

- design and maintain a web-based database that would have information on current and past groundwater and surface water quality and quantity in Ontario.
- baseline monitoring of groundwater and surface water quality and quantity in Ontario with data available on the web site described above.

New Business: Paul Sibley's nomination for Chair was passed unanimously. Paul has agreed to assume the Chair position starting next year.

SERVICING AGRO-METEOROLOGICAL NEEDS IN ONTARIO: REPORT OF THE ONTARIO AGRO-METEOROLOGY RESEARCH AND SERVICE COMMITTEE

Compiled by Jon Warland and Terry Gillespie

Summary

This report details agro-meteorological research and service in Ontario for the year 2003. Because the committee's last report emphasised research priorities, this year's report focuses on current service and recommendations for strengthening agro-meteorological services in Ontario.

The second section of the report details the activities of the Ontario Weather Network, based at Ridgetown College. This group has made a tremendous effort to implement a practical, real-time weather network and use the data to make real-time forecast products for growers. This committee strongly endorses their efforts and recommendations for public support.

The third section of this report describes the results of the Surplus Water Project. This project was able to estimate safe dates for waste applications to land, and this committee supports their recommendation to use their techniques to compile maps for Ontario detailing safe application dates as part of the new Nutrient Management Legislation.

The fourth section reports on research and service by the agrometeorology group at the University of Guelph. The research is strongly driven by questions relating agriculture to greenhouse gas mitigation and air quality issues. This section also reports on the researchers' involvement with the Ontario Weather Network.

In the fifth section the current work at the Simcoe Campus of the University of Guelph is summarized. Alan McKeown further recommends that funding for microclimatic management and precision horticultural production needs to be developed in Ontario, especially since producers in other provinces are beginning to utilize such tools.

The sixth incursion is a brief report from AAFC-Ottawa, who are currently undergoing major structural changes in their research division.

This report concludes with a summary of the committee's recommendations for improving and enhancing agro-meteorological service in Ontario.

1. Ontario Weather Network, Ridgetown College, University of Guelph

Contributed by Ian Nichols

Background

The Ontario Weather Network (OWN) concept was born during the January--March 2000 period. Dr. Ron Pitblado, Dr. Art Schaafsma, and Brian Doidge determined that an investigation into the feasibility of a cost recovery weather based modeling service was warranted as a

result of OMAF(RA) changing strategic directions. Ian Nichols was asked to lead up this investigation. OWN was formed to provide producer groups a mechanism for operating IPM programs efficiently and to allow for the easy adoption of new IPM tools and techniques. It

has expanded to include various research and delivery activities where the need to support agriculture has been identified and where funding is available. The support of the staff on the University of Guelph main campus, and that of Dr. Terry Gillespie and other Land Resource

Science researchers in particular, has been extremely valuable to the OWN program. After several seasons of modest growth, the Ontario agricultural community is providing greater support for the delivery of grower level agronomic programs. OWN, having studied, developed

and tested the necessary equipment, systems and markets to deliver such programs, is very well positioned to provide broad coverage for agromet services in Ontario, whatever the source of clients or funding initiatives. OWN is operated as a non-profit cost recovery program out of the Ridgetown Campus of the University of Guelph.

OWN Vision

The OWN vision is to establish an 'agricultural wide' network which produces programs that create value for clients. OWN will serve research, production and policy needs for agro-meteorological information. We link researchers and producers together with easy to

use advisory products. OWN will remain positioned to develop new Ag-Met programs through research, sponsorship funding and commercialization.

Structural Changes Affecting Agro-Meteorology in Ontario

Many changes in services have occurred over the last several years which impact the availability of information and services. Environment Canada (EC) discontinued their agricultural web page and they are currently reducing their volunteer observer program. AAFC has restructured and the responsibility for the national agro-climate network is hosted in Western Canada. There is no plan at present to allow AAFC to support regional networks. Some key stations in the AAFC station network have been replaced by EC stations. Some U of G locations have also been upgraded with EC equipment. OWN has assumed operations of the twelve Niagara Agricultural Weather Network stations. These stations were originally supplied by Campbell Scientific Canada (Edmonton) who formerly maintained an office in Chatham Ontario. Even some large

media firms are having difficulty finding sponsorship for Agricultural weather programming. We believe that the manual observation program in Ontario will continue to shrink

except in cases where a value added program can use historical information and where the use of internet reporting can assist with site specific assessments. Automated weather observation sites will grow as technology improves and as more IPM models can show economic benefits, but it appears few organizations have the interest in developing broad-based regional programs which can help a variety of clients.

OWN Operations

OWN delivers numerous reports to different ag-industry sectors to assist with production and marketing management decisions. We also support researchers with both real-time and historical information. OWN archives data and processes information from several sources to meet these needs. We also have a number of physical operations relating to the acquisition of data. These include:

- 1) Construction of sensors and adaptation of sensors to loggers.
- 2) Designing and assembling custom made sensors
- 3) Installation, calibration and repair of weather station equipment.
- 4) Modifying and managing communication systems (e.g.~radio, land phone, cell phone, ftp).
- 5) Modification and operation of data acquisition software (Campbell Splits, ADCON ADDvantage and others).
- 6) Transfer of raw data into database (SQL database with a Java interface).
- 7) QC checking and improving internal data management process.
- 8) Model processing (some manual, some automatic) and archiving.
- 9) Creation of images, maps, graphs, charts (MS excel, ArcView, Surfer, etc. automated with Visual Basic).
- 10) Finding and creating new uses and report formats for data.
- 11) Finding and archiving historical records for report and research purposes.
- 12) Field testing new models in conjunction with researchers.
- 13) Posting information on the web (currently using Cold Fusion).
- 14) Delivering custom reports via. fax, email, ftp, etc.

OWN Strengths and Opportunities

1. The OWN team is very talented and resourceful. The data collection is growing. College and University staff are extremely supportive but more promotional work should be done to highlight the opportunities to use the OWN resources.

2. Development work on system automation has progressed to the point where substantial efficiencies are being realized in report generation but more work still needs to be done in this area.

3. Our program has tremendous reach and opportunity for growth but the team is small and needs to establish some redundancy in the GIS, database and electronics skills.

4. The OWN program has no base funding and has to continually invest a lot of time on competitive funding which limits our ability to serve clients efficiently. An appropriate funding model should include 30\% to 50\% of revenues as base funding to allow more free access of information by researchers and extension personnel.

5. OWN is still relatively new and the capital requirement of establishing networks is considerable so growth is often limited by capital needs.

OWN Deliverables

Table 1 reviews the major delivery programs of OWN. OWN also supplies various information packages to agribusinesses and these reports and clients are not specifically named.

Commodity or Program	Commercially Delivered Programs	Transition Programs Needing funding or validation/demonstration	Projects in Research (or requiring more research)
Tomato	TomCast Site Specific applications	Irrigation	Ethrel Stink/Plant bug
Sugarbeet	BeetCast Microrate Site Specific Apps.		Yield Fall Frost advisory
Wheat	DonCast	Site Specific Applications	
Seed Corn	Winter Temp. Index		Irrigation model
Grapes	Icewine	Temperature Inversion/ Frost Protection model	Irrigation model Downey mildew Powdery mildew
Tender Fruit	GDD		Irrigation model
Apples		Numerous models in various stages	
Onions		BotCast	
Carrot			
Potato		Late Blight Early Blight	
Custom Monitoring	Temperature. Precipitation CHU, GDD values	Wind – spraying times	
Volunteer programs		Climate observer groups	
Information	Ontario Farmer CropPest Agriphones Drought Monitor		
Rural Fuel Dist.	HDD		

Long term Visions for Ag Met Services

Ontario needs a better funded Ag-Met program. We continue to see opportunities to develop new partnerships and service revenues but there are development costs involved to get this accomplished. Commodity groups seem to be willing to support program delivery but program and infrastructure development (with the exception of short term research) is typically beyond their budgets and mandates. Producer boards are asked to support research (often to 50% of costs) and weather based modeling services (typically to 100% of costs). Finding the funds to support OVN's labour costs to create and maintain infrastructure, to establish ongoing network partnerships and systems, is really beyond a reasonable expectation for a producer board. These infrastructure maintenance, development and partnering activities should be seen as a separate activity to the delivery of the models and advisories that producer groups need to directly support. As such they should be considered more of a public good and supported accordingly.

2. The Water Surplus Project and its Spinoff: A Report for Ontario AgroMeteorology Research and Service Committee

Contributed by Murray Brown

Seasonal and Annual Water Surplus in Ontario

Following the publication of a Report (Fallow et al. 1999) and a Scientific Paper (Parkin et al. 1999) on the frequency and occurrence of seasonal and annual water surplus for four sites in Ontario in 1999, it was decided to assemble daily climate data for three more provincial sites in contrasting climatic regions. These data were assembled for the 1954 to 2001 period for:

- 1) Emo/Fort Frances in the Rainy River district to represent a low winter precipitation region;
- 2) Mount Forest (Walkerton) in the snowbelt district to the lee of Lake Huron; and Smithfield in the east central district, near the Prince Edward county region, where summer precipitation can be scarce.

Daily climate data for the four original sites (Harrow, Guelph, Ottawa and Kapuskasing) were updated to the end of 2001 as well. The daily climate data assembled for these sites included: maximum, minimum and dewpoint temperatures, precipitation, wind run and sunshine hours or solar radiation, required for the SHAW model used in this and the previous study.

In addition to the local climate, typical soil profile conditions and hydraulic properties for each soil type, along with seasonal growth characteristics for a corn crop in each climatic region were used as input to the SHAW model. In order to provide a uniform

comparison of water budgets among regions, the Embro silt loam soil profile properties were used in a simulation at all seven sites along with the corn crop growth conditions typical for the region.

The input and boundary conditions of the SHAW model (a one-dimensional, deterministic model of water and heat flow in the soil including crop uptake of water and freeze/thaw determinations) were updated also to provide a better depiction of regional water budgets than was accomplished in the previous study.

Outcomes

The major findings of this investigation (Fallow et al. 2003) were:

- 1) Average annual water surpluses ranged from 152 mm at Harrow in the southwest to 405 mm at Mount Forest in the snow-belt region east of Lake Huron, when the typical soil type was assumed for each region.
- 2) There was significant year-to-year variability in the annual water surplus, and therefore for the potential risk of surface water and groundwater contamination at each site, with most of the surplus occurring in the winter and spring seasons.
- 3) Most of the water surplus in the winter season was estimated to be runoff at all sites except Smithfield, where there was twice as much deep drainage as runoff, and at Guelph and Mount Forest there was only slightly more runoff than deep drainage for the typical soil profile. The relative values of deep drainage and runoff changed considerably in the winter season for the Embro soil. For example, average deep drainage became negative at Emo, and was much less than runoff at Guelph, whereas deep drainage was estimated to be three times as much as runoff at Mount Forest.
- 4) In the spring season when water surplus and potential risks of surface water and groundwater contamination were quite high, the relative values of average deep drainage and runoff remained fairly comparable between the two soil types at most sites. At Emo and Harrow, estimated deep drainage increased considerably for the Embro soil compared to the typical soils at these two sites in the spring.
- 5) Average deep drainage in the typical soils was significant in the summer and fall seasons at all sites, except in the summer at Emo and in the fall season at Guelph and Harrow. Deep drainage exceeded 50 mm during the summer season in more than half the years at Kapuskasing and Smithfield and in half the years at Guelph and Ottawa. In the fall season deep drainage exceeded 50 mm in half the years at Mount Forest and in one-third the years at Kapuskasing, but in only five years or fewer at the other sites.
- 6) Average runoff was insignificant in the summer and fall seasons at all sites in southern Ontario and only exceeded 50 mm in the summer season in 9 years out of 48 at Emo and in 5 years at Kapuskasing.

7) The dominant factor that determined surplus water was when excess precipitation occurred in any season.

8) Soil types with relatively high hydraulic conductivity had considerably more deep drainage than soils with high clay content that drained slowly. The soil profiles with a coarse texture in the lower layers also provided more opportunity for conduction of water upward into the rooting profile of the crop when the soil was saturated just below the rooting depth and resulted in more transpiration.

9) Caution needs to be exercised with respect to contaminant transport particularly in areas where sandy soils occur, and in the snow belt regions to the lee of the Great Lakes, as deep drainage was excessive in the wet seasons and wet years in these situations.

Spinoff from Water Surplus project

During the hearings in connection with Ontario's legislation on Nutrient Management, there were concerns expressed re: the 'safe seasons' when farmyard manure and sewage sludge can be applied to the land. As a result staff at OMAF asked if it was possible to determine these 'safe seasons' from past climate data for all regions in Ontario. OMAF staff provided criteria re: frozen/thawed soil and snow depth conditions.

The SHAW model used in the Water Surplus project for seven regions in Ontario proved capable of determining the dates after which in the spring and before which in the fall that manure/sludge could be applied with optimum safety. Thus the SHAW model was applied to the same climate data used in the Water Surplus project (Fallow et al. 2003) to determine these safe dates each year for different soil types in each of the seven regions. Now OMAF wants maps that depict these dates throughout Ontario for soils with different surface textures.

References

Fallow, D.J., G.W. Parkin, C. Wagner-Riddle, and D.M. Brown. 1999. Estimated Annual Water Surplus for Four Regions in Ontario. Land Resource Science Tech. Memo No. 99-1. 38 pp.

Fallow, D.J., D.M. Brown, G.W. Parkin, J.D. Lauzon and C. Wagner-Riddle. 2003. Identification of Critical Regions for Water Quality Monitoring with Respect to Seasonal and Annual Water Surplus. Land Resource Science Tech. Memo 2003-1. 149 pp.

Parkin, G.W., C. Wagner-Riddle, D.J. Fallow, and D.M. Brown. 1999. Estimated Seasonal and Annual Water Surplus in Ontario. Canadian Water Resources Journal, 24: 277-292.

3. Report of the Agro-meteorology Group, Land Resource Science, University of Guelph

Contributed by Terry Gillespie, Claudia Wagner-Riddle and Jon Warland

Research

Our work examining the effects of agricultural management practices on greenhouse gas exchange continued. Long-term measurements of nitrous oxide, carbon dioxide and water vapour exchange are continuing over conventional and best-management fields at the Elora Research Station. This year the experiment is expanding to include manure applications on some fields. Significant results include:

- 1) Best management practices applied to a corn/soybean rotation resulted in reduced losses of N to the environment, when compared to conventional practices (19 vs. 42% of applied N, respectively), while maintaining similar yields.
- 2) Environmental losses of applied N in the form of N₂O (a greenhouse gas) were reduced by 40% when best management practices were implemented in a corn/soybean rotation.
- 3) The value of maintaining agricultural surfaces in southwestern Ontario as one aspect of air pollution abatement (NO₂ removal), can be estimated from crop water use.

To complement greenhouse gas flux measurements and soil nitrogen studies at the Elora research station, fluxes of the more reactive nitrogen gases — nitric oxide (NO) and nitrogen dioxide (NO₂) — are now also being measured over the conventional and best management plots which were planted to corn in 2003. These measurements relate to the total nitrogen budget of the management systems, and to the interaction of the management systems with the regional smog problem. The latter relationship occurs because NO and NO₂ (collectively called NO_x) are involved with the photochemistry of ground-level ozone production. A supporting indoor study of NO₂ uptake by soybean leaves has also been completed in a controlled environment. Soybeans will be planted in the test plots in 2004.

Both indoor and outdoor results reveal that the plants and soil are a small source of NO and a significantly larger sink for NO₂. This means that agricultural surfaces are having a positive effect on air quality in the southern Ontario region because they are net consumers of precursors to ozone smog. Data analysis and continued monitoring is underway to determine if there are significant differences in NO_x fluxes between conventional and best management practices.

Service

In cooperation with the OWN group at the Ridgetown campus, ways of providing weather-based disease management advice to an expanded number of growers in

southern Ontario are being investigated. A significant challenge in providing these services is the measurement or estimation of leaf wetness duration (LWD). A visiting Professor from Brazil, Dr. Paulo Sentelhas, is evaluating several physical models for estimating LWD in a variety of crops from weather station data, and doing an intensive evaluation of cylindrical wetness sensors relative to the more expensive, conventional flat plate sensors. A graduate student is investigating the use of weather radar data to estimate the duration of rainfall at sites where no direct monitoring is available. Accounting for LWD due to rain is particularly difficult because precipitation is so spatially variable during the growing season, but weather radar is a promising potential solution to this problem.

4. Report from Simcoe Campus, University of Guelph

Contributed by Alan McKeown

Adam Dale's blueberry irrigation work is ongoing. His current focus is looking at various means to schedule watering, including daily irrigation, based on tensiometer measurements, through potato model output and by evapotranspiration replacement.

I have two projects looking at combinations of irrigation levels and nitrogen (base level + fertigate) trying to find a combination that maximizes yield and quality with minimum resources. We also will try to compare evapotranspiration use with soil moisture readings.

Weather station maintenance and funding is still an issue. We currently pay for it out of our limited research dollars. Furthermore, due to intrusions, we had to set a security code in the data program. Therefore OWN is not getting the data. We do not have time nor resources to put the data out in another format.

We clearly foresee the day when microclimatological management, especially in high value horticultural crops, will come. Developing this is both a service and research issue. There is a lot of interesting work currently underway in BC, for example they have developed an integrated temperature probe and radio on an Intel computer chip. This technology will allow micromanagement for irrigation, frost control, maturity and more. Ontario is being left behind in this area because of lack of funds for research in microclimatic management and precision horticultural production. Great useful in-depth and applied co-operative potential exists in this area if it can be encouraged and funded.

5. Report from AAFC-Ottawa

Contributed by Henry Hayhoe

I am finding it difficult to report to the OARSC given the changes which are taking place in AAFC. I am now part of a National Study Title entitled 'Adapting the Agri-Food Sector to Climate Change'. The national study leaders are Dr. Sam Gameda (Ottawa) and Dr. Denise Neilson (Summerland). The national study is part of the Environmental Health theme directed by Dr. Barry Grace (Summerland).

As you are aware, Andy Bootsma has retired, but continues as an HRA. He provided me with the following for a report:

My commitments under my HRA status in AAFC for this year involve the following (in collaboration with Sam Gameda):

1. Complete two scientific papers on the potential impacts of climate change on agroclimatic indices and on crop production in the Atlantic region of Canada.
2. Complete a technical report on the potential impacts of climate change on agroclimatic indices in Ontario and Quebec.

I am also a co-author on a paper being submitted for publication on potential impacts of climate change on winter damage to deciduous fruit trees in eastern Canada. Philippe Rochette from Sainte-Foy Research Centre is the lead author.

In addition to Andy's activities, we continue to maintain the daily climate archive for Canada. New software has been implemented to speed the updating process and to improve methods used to estimate missing data. In cooperation with Dr. R. Motha, President of the WMO Commission for Agricultural Meteorology, USDA Washington DC, we have drafted a chapter entitled: 'Agricultural Meteorological Data, their Presentation and Methods of Analysis' for the revised Guide to Agricultural Meteorological Practices. As part of a CCAF project we are using stochastic weather data generators to develop climate change scenarios for Canada.

6. Recommendations

Research

1) The committee continues to endorse the recommendations for research priorities put forward in last year's report. In particular, climate change mitigation and adaptation, including water use and efficiency, continue to be high priority.

Service

2) The committee supports the goal of obtaining 30--50% of OWN's operating budget from public funds. We request that the Soil, Water and Air Research and Service Committee also endorse this goal and establish a small task force to pursue ways of attaining this goal. Initial efforts might be through the Associate Vice-President--Agrifood Partnerships at Guelph who manages the OMAF contract with Guelph, though OWN's services have many potential applications beyond OMAF, including the Ministry of Natural Resources and the Conservation Authorities.

3) Assign one OMAF IPM position to OWN for one year to improve development and delivery of services. OWN would benefit from a close working relationship with an end-user of its products, and we believe OMAF would benefit through increased knowledge of and access to the resources we have.

4) Develop 'safe application' maps for Ontario based on the work of the Water Surplus Project. The project has shown that it can calculate when the water budget is in surplus, and this information should be publicly available to assist in safe waste management.